Smart city lights and smart house devices.

Vasiliki Servou | 27/04/2022

As part of the code4SDG11 (https://twinspace.etwinning.net/201884/home) etwinning program, in the computer science classes, the micro:bit's light and tilt sensors were programmed to create smart city lights and other related devices. An interdisciplinary lesson scenario was created for learning and understanding various programming concepts, such as a) input, output b) repetition, c) selection, d) variables, e) procedures & functions, and logical operators through the creation of applications for Sustainable Development Goal 11 (Sustainable cities and communities). This scenario was taught to the A, B and C high school classes.

The students studied the problems of their city, Athens, and their neighbourhood, Kareas. Among other things, the students researched and examined the main problems connected with the operation of street lights, which are either controlled manually or turned on at a given time. Thus they found that the city currently has traditional street lights which use a lot of electricity, and sodium lamps which are expensive to replace. They also found that most modern city lights have a light sensor that turns the light on when a light threshold is reached e.g. 150. Even these are inefficient, as the lights remain on continuously throughout the night with the same brightness.

So it was thought that the city needed new street lights that would use sensors to detect light levels and react to different light levels with different intensities.

Students' findings and thoughts were presented in plenary, in the classroom and published on the twinspace for our partners to see and discuss.

The purpose of the learning scenario and its related activities was to raise students' awareness of sustainability, to cultivate problem-solving skills, computational thinking, and social skills, as well as to deepen their understanding of basic programming concepts and learn new ones.

Based on a scenarios published by BBC micro:bit.

LEARNING OBJECTIVES

Deepening the students' understanding of programming concepts: input, output, iteration, selection structure, variables and event-oriented programming.

Learning procedures-functions, logical operators and Boolean algebra.

Developing problem-solving skills, collaboration skills, communication and critical thinking skills, creativity and decision making and cultivating computational thinking.

Raising students' awareness od sustainability and in particular of target 11: Sustainable cities and communities.

Students learn how to meet deadlines, how to deal with failure and how to self-reflect on their work.

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

AGE GROUP

From 12 to 15

SCENARIO LANGUAGE

English

TOTAL DURATION

4 hours 35 minutes

SUBJECTS

CROSS CURRICULAR | INFORMATICS / ICT

SMART LIGHTS FOR SAVING ENERGY.

15 MINUTES

How the micro:bit could be used to improve street and house lights to save energy?

INVESTIGATE & RESEARCH

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Computers, Internet, Microsoft Make Code Editor, projector or a screen broadcasting software

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students work in pairs to reasearch the light sensor of the micro:bit on the internet, on the site https://microbit.org/ and on the Microsoft Make Code Editor and make an algorithm for the micro:bit to turn on its LEDs, depending on the ambient light, as well as to make its screen brighter or darker depending on the amount of light that falls on it.

The teacher monitors all groups, gives help and guidance when needed and ensures that tasks are completed in time.

Some groups present their work in plenary and a discussion follows with any questions the students may have.

The teacher summarizes and finalizes the results and the algorithm and shows the algorithm via screen broadcasting software on every screen or via a projector.

15 MINUTES — Program the smart lights

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Computers, Microsoft Make Code Editor, BBC micro:bit, Internet, screen broadcasting software or projector.

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students work in pairs to write the program for the previous algorithm, test it on the Microsoft MakeCode Editor, flash it on the micro:bit and test it. They exchange their products with their peers and test them.

The teacher monitors all groups and helps and guides when needed and ensures the tasks are completed in time.

Two or three pairs present their work in plenary and a discussion follows with any questions the students may have.

The teacher concludes.

20 MINUTES — Contempletating about their product

EXCHANGE & DISCUSS

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Computers, internet, epoptes, projector

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students are asked to work in pairs and to find out where this device could be used and connect its uses with the SDGs.

They search on the internet on the micro:bit site, exchange ideas, and connect their answers with the SDGs and every group shares their results to the plenary.

The students are also encouraged to explore the problem of by-fishing, its impact and possible solutions and augment the above model with sound so that it can be used in fishing nets to reduce the problem of by-fishing.

Students are prompted to study the problem of sea turtles and create an original beach light using micro:bit LEDs so that new born turtles can safely find their way to the sea.Goal 14: life under water. 14.2: sustainable management and protection of marine and coastal ecosystems.

The teachers monitors all groups, gives help and guidance when needed and ensures the tasks are completed in time.

Some pairs present their work in plenary and a discussion follows with any questions the students may have.

The teacher concludes making sure to include the following:

This technique can be used for smart city lights, night room lights, outdoor lights, bicycle saddle lights, and wearable devices especially for children with mobility, hearing and vision problems, as well as for animal safety. Goal 7: cheap and clean energy. Goal 11: sustainable cities and communities, Goal 11.1 sustainable and affordable housing, Goal 11.2 improved road safety, paying particular attention to the needs of those at risk, such as women, children, people with disabilities, the elderly and migrants, Goal 11.3 Inclusive and sustainable urbanization, Goal 11.6 Reduce the environmental impact of cities,Goal 11.9 Implement policies for inclusion, resource efficiency and disaster risk reduction,Goal 11.A Support least developed countries in sustainable and resilient building, Goal 12: responsible consumption and production.

10 MINUTES Selection structure

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Microsoft Make Code Editor, Internet, screen broadcasting software or a projector.

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students are asked in pairs to modify the algorithm of the previous activity to use the selection structure to control whether light falling on the micro:bit falls below a certain light level e.g. 100, which means that it is dark and turns on the LEDs on its screen, otherwise it turns off the LEDs on its screen.

The teacher monitors all groups and offers help and guidance when needed, ensuring that tasks are completed in time.

Some pairs present their algorithms in plenary and a discussion follows with any questions the students may have.

The teacher concludes and presents the answer to the plenary.

15 MINUTES Programming using the selection structure.

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Computers, Microsoft Make Code Editor, micro:bit classroom, BBC micro:bit, screen broadcasting software or projector

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students work in pairs to write the program for the previous algorithm, test it on the Microsoft MakeCode Editor, flash it on the micro:bit and test it. They exchange their products with their peers and test them.

The teacher monitors all groups and helps and guides when needed, ensuring the tasks are completed in time.

One pair presents their solution to the plenary and a discussion follows with any questions the students may have.

The teacher concludes using a screen broadcasting software or a projector.

30 MINUTES — Algorithm for smart lights activated and deactivated by buttons A & B.

INTERACT & INSTRUCT

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Parer, pens, computers, word processor, projector or screen broadcasting software

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students are asked to modify the algorithm of the previous activity so that the device can be activated by pressing button A and deactivated by pressing button B. They work in pairs. The teacher passes from all groups and helps and offers help and guidance when needed.

This resulted in a more complex algorithm. The teacher points out that the algorithm is more complex now and introduces procedures to simplify it.

The students simplify their algorithms using procedures and one pair presents their work in plenary. A discussion follows with any questions the students may have.

The teacher concludes.

30 MINUTES — Coding the smart lights so they are activated and deactivated by pressing the buttons A & procedures.

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

computers, micro:bit classroom, projector, screen broadcasting software

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students work in pairs to code the algorithm they made using procedures. They test it, they flash it on they micro:bit and test it. They exchange their programs and micro:bits with other groups.

One pair present it in class and a discussion follows with any questions the students may have.

The teacher concludes.

A SAFETY AND ANTI-THEFT DEVICE.

15 MINUTES

Adding sound and radio

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING

TOOLS

micro:bit, microbit classroom, computers, projector or screen broadcasting software

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students are asked to explore the micro:bit's capabilities of sound and radio and add them to their previous device so it can make sound and send radio messages when they are in danger.

The students work in pairs and explore the micro:bit's capabilities in that direction and modify their code. They test their code on the simulator, they flash it on the micro:bit and they test it there. They exchange their micro:bits with other pairs for further testing.

The teacher is at the side, monitors all groups and helps and guides when it is needed, ensuring that all tasks are completed in time.

Some pairs present their work in plenary and a discussion follows with any questions the students may have.

The teacher encourages the class to think of possible uses of this prototype. A discussion follows.

SOUND ACTIVATED LIGHTS BOOLEAN LOGIC AND ALGEBRA

15 MINUTES

Boolean Algebra and Logic

INTERACT & INSTRUCT

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING

TOOLS

whiteboard, computers, projector or screen broadcasting software

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Public	Together	Teacher-led

DESCRIPTION

The students are prompted to think if they have come across any sound activated lights. Discussion in plenary follows and students are prompted to do a short relevant search on the internet.

The students are prompted to think how such devices work. A small discussion follows.

The teacher introduces the operator NOT and Boolean Algebra and Logic and explains how it functions in such devices. Following this, there is time for questions.

15 MINUTES

Programming the sound activated lights

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Computers, BBC micro:bits, micro:bit classroom, projector or screen broadcasting software

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The teacher shares the code blocks that are needed to construct the program and asks the students work in pairs to join them together so they make the sound activated lights program. In pairs, the students place the blocks in the right order, test the program in the simulator, then flash it on the micro:bit and test it. The teacher monitors all groups, gives help and guidance when needed and ensures the tasks are completed in time.

One pair presents their work in plenary and a discussion follows with any questions the students may have.

The teacher concludes.

TILT SENSOR

15 MINUTES

Investigate the tilt sensor

INVESTIGATE & RESEARCH

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING

TOOLS

computers, search engines, Microsoft Make code for micro:bit, word processor, presentation software, screen broadcasting software or a projector.

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students are asked to investigate the tilt sensor of the micro:bit and how it can be used. They are encouraged to look at the microbit.org site. They are also asked to find out how smart devices with the tilt sensor are being used.

The teacher monitors all groups, gives help and guidance when needed and ensures the tasks are completed in time.

The students work in pairs and share their findings with other pairs and some pairs present their findings in class and a discussion follows with any questions the students may have.

The teacher concludes that they can make a prototype which could be used for the elderly or the sick when they are alone in the house. For example, if they fall, the micro:bit will send a warning message about it. It could also be used as a wireless alarm to warn you when someone opens a door or moves your bag. You can keep your valuables safe with this radio-controlled burglar alarm.

15 MINUTES — Program a radio controlled tilt alarm.

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

computers, BBC micro:bit, micro:bit classroom, screen broadcasting software or a projector

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students are asked to make an algorithm for the devices they found before.

They work in pairs and echange their algorithms. The teacher walks around the groups, watches their work and gives advice and encouragement when it is needed and ensures the tasks are comleted in time.

One pair presents their algorithm in plenary and a discussion follows with any questions the students may have.

The teacher concludes.

Then the students work in pairs to write the relevant program, test it on the Microsoft Make Code Editor and flash it on the micro:bit and test it there too. The groups exchange micro:bits and test their classmates' products.

One pair presents their product in the plenary, follows short discussion, and the teacher concludes.

20 MINUTES — Radio controlled tilt and light alarm.

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

computers, BBC micro:bit, micro:bit classroom, screen broadcasting software or a projector

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students are asked to combine the previous programs they made: light sensor and tilt sensor radio controlled alarm to make a Radio controlled tilt and light alarm. They discuss that they have to use the operator OR they have been taught before.

They work in pairs and make the prototype, then test it and the groups exchange devices to test.

The teacher monitors all groups and helps and guides when needed, ensuring all tasks are completed on time.

One group presents the program in the plenary and a discussion follows with any questions the students may have.

The teacher concludes.

PRESSURE SWITCH ALARM

20 MINUTES

Pressure switch alarm

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CREATIVITY

TOOLS

cardboard, foil, computers, BBC micro:bit, micro:bit classroom, crocodile cables, screen broadcasting software or a projector

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher-led

DESCRIPTION

A wireless intruder alarm will be created that warns you when someone steps on a home-made pressure sensor.

The teacher instructs the students to work in groups to make the following:

A pressure input switch out of cardboard and tin foil. It can be folded over and placed under a rug or carpet. Some foam might be needed to keep each side apart. The two foil pads will be connected on one side to pins 0 and GND on the sensor micro:bit. When you step on it, the foil on the top completes an electrical circuit and it sends an ‘intruder’ radio message. Multiple sensors can be added each sending its own message, e.g. ‘room1’, ‘room2’ and, in this way, the alarm can indicate where the intruder is.

The students work in pairs to make the construction, program and test it.

The teachers monitors all groups, gives help and guidance when needed and ensures the tasks are completed in time.

One pair presents their device in plenary and a discussion follows with any questions the students may have.

The teache concludes.

15 MINUTES

Programming the pressure switch alarm

CREATE

C'S OF EDUCATION

COLLABORATION | COMMUNICATION | CRITICAL THINKING | CREATIVITY

TOOLS

Computers, BBC micro:bit, micro:bit classroom,

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

The students in pairs make the algorithm and the programm for the pressure switch alarm.

They test it on the micro:bit classroom and on the device they made.

The teacher passes form all groups and helps and guides them when it is needed, ensuring that tasks are completed in time.

Some groups present their work in plenary and a discussion follows with any questions the students may have.

The teacher concludes.

EVALUATION

10 MINUTES

Quiz

ASSESSMENT & FEEDBACK

C'S OF EDUCATION

COMMUNICATION | CRITICAL THINKING

TOOLS

Online quiz platform and a quiz prepared by the teacher in advance.

SPACE FORMAT	POSITION OF LEARNERS	ROLE OF TEACHER
Private, limited distraction	Small groups	Teacher at the side

DESCRIPTION

A short, ungraded online quiz to check for understanding (True/False, multiple choice, matching, etc.). Students can discuss their answers in pairs before answering. Both students and the teacher receive immediate feedback. Depending on the type of quiz (with questions displayed on the main screen or on students' devices only), the teacher can provide general feedback for the whole class group or students can work independently on the feedback provided on their screens.

Co-funded by the Erasmus+ Programme of the European Union

NOVIGADO

The Scenario Tool has been created within the Novigado project, which is funded with support from the European Commission's Erasmus+ Programme. The Scenario Tool and any of its content reflects the views only of the author(s), and the EC cannot be held responsible for any use which may be made of the information contained therein.